

The Phenomenon of Growing Popularity of It Education and Its Impact on the Global Economy

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ABSTRACT

This article examines important aspects of information technology education in Ukraine as a historical and pedagogical phenomenon. Special attention is paid to the place and role of Ukrainian information technology education in the global IT market. The article also conducts a retrospective analysis of socio-economic, legal and historical-pedagogical conditions of formation and development of information technology education in Ukraine. It identifies the main stages and trends in the development of this industry, analyzes the formation of digital skills among school graduates and the specifics of training IT specialists for professional activities in the conditions of digitization of the labor market. The main problems of training IT specialists of various specialties in higher educational institutions and their readiness for employment in the IT field are investigated. A SWOT analysis of IT education in Ukraine was carried out. Prognostic substantiation of the further development of IT education in Ukraine in the conditions of economic recovery after the war and reform of the educational system is carried out.

Keywords: Information technologies, phenomenon, digitalization, IT specialists, global economy

I. INTRODUCTION

In countries with strong economies, ICT (Information and Communication Technologies) are widely used for interaction between the state, business and citizens. This requires constant improvement of the quality of all levels of IT education.

Among the most important tasks for the further development of Ukraine after the war is the creation of a modern and secure information society, in which digital technologies act as a tool for improving the welfare of citizens and social progress. Information knowledge, skills, resources and technologies are key factors in the development of the information society. Therefore, the training of highly qualified personnel capable of developing and using IT technologies for the recovery and development of the country's economy becomes a priority task of the education system [7]. To achieve this goal, it is necessary to actively develop the national system of IT education, which meets the modern requirements and needs of the labor market. The shortage of specialists in the field of information technologies in Ukraine is considered critical and has remained at a high level for the past ten years, reaching from 30 to 80% according to some estimates. Most graduates of higher educational institutions with relevant specialties have difficulties with employment in the field of IT, which indicates a lack of qualified personnel meeting the requirements of modern industry. A small part of Ukrainian IT specialists has a high level of competence in the most promising technological areas, such as artificial intelligence, big data (Big data) and the Internet of Things. Therefore, the training of qualified IT specialists

who would meet the modern requirements of the labor market becomes an extremely important task for the modern education system in Ukraine. The relevance of the article is due to numerous contradictions between the general recognition of the importance of digital skills for all participants of modern society and the incompatibility of regulatory and legal and organizational and pedagogical mechanisms of their formation. For example, although there are high official goals regarding the digitization of the education system and increasing the digital competence of future professionals, their implementation may be complicated due to the lack of clear regulatory and organizational guidelines. This research is important to resolve these contradictions, as it will reveal the causes and ways to overcome the shortcomings in digital education. Revealing such contradictions will help to develop more effective strategies for introducing digital technologies into the educational process, as well as to ensure more effective development of digital skills among all segments of the population [1]. Thus, this study is relevant and important for the further development of the educational system and the training of future specialists in the digital era.

II. ANALYSIS OF THE LAST ONES OF RESEARCH AND PUBLICATIONS

The study of scientific publications and official analytical sources regarding the training of specialists for the IT sphere and digital society in Ukraine shows the existing shortage of personnel. This indicates the need for significant restructuring of approaches to their education. The following measures are proposed: review of the role of IT education as a socio-pedagogical phenomenon; emphasis on the training of specialists for IT and related sectors of the economy, as well as on the education of competent users of digital technologies; update of educational programs; changing approaches to professional orientation; system development retraining; harmonization network educational institutions; creation favorable conditions for academic freedom, independence teachers and personal implementation students [2].

On scientific levels the concept of «IT education» is considered complex an interdisciplinary phenomenon that combines «digital education», «media education» and «informational education». From a pedagogical point of view it is defined as a key aspect of personal development into digital era, where the level possession digital technologies determines personal success and social comfort. IT education covers active cognitive acquisition and improvement activities digital knowledge, abilities and skills, transfers accumulated digital knowledge to the younger generation, forming in them appropriate values and cognitive opportunities The result is formation personality digital era that has a digital system knowledge, abilities and skills necessary for success in modern labor markets and active participation in the digital society. It also a system of subjects educational activities that are carried out on different levels, in various forms and types, contributing development educated members of the digital society and qualified specialists in the field of IT [3].

Ukrainian educational space like others spheres life country, experienced significant losses and destruction due to full-scale intrusion of Russia in February 2022. Important influence had also the events of 2014 and the pandemic COVID -19. In July 2014 there was the adopted Law of Ukraine «On Higher education» which establishes the main ones legal, organizational and financial principles of functioning systems higher education. The law creates conditions for strengthening cooperation between government bodies, business and higher education institutions education on the basis of autonomy, combination education with science and production, for the purpose of preparation competitive human capital for high-tech and innovative development countries, self-realization personality , as well as provision of the needs of society , the labor market and the state in qualified persons specialists. According to this law, it is necessary create a system of internal and external software quality higher education, which will be based on standards that operate in countries of the European Union. During quarantine restrictions, educational institutions switched to distance education to provide protection population and minimize spread diseases armed aggression that began in 2014, a pandemic COVID -19 is in full swing the invasion of 2022 is significant made it difficult situation in Ukrainian educational spacious In 2014 about 20 institutions higher education forced were to evacuate from Autonomous Republic Crimea, parts territory Luhansk and Donetsk regions due to illegal occupation these territory From the beginning of full-scale wars, 365 establishments education (schools, preschool children's institutions houses, vocational schools, universities) were fully destroyed, and 3798 establishments were damaged Statistics regarding quantity damaged and destroyed institutions is conducted on a special platform Ministries of education and science of Ukraine SaveSchools, where available an interactive map with information about the state of institutions in each region. Significant destruction educational institutions recorded in Kharkiv, Donetsk, Luhansk, Zaporizhzhia, Dnipropetrovsk, Mykolaiv, Kherson, Kyiv regions and the city Kyiv. For example, as of March 2024 in Donetsk region was 174 establishments were destroyed of education , and 631 were damaged. In Kharkivska region was 51 institutions were destroyed and 579 were damaged.

However, the Ministry of education and science of Ukraine reported that as of January 25, 2024, the restorative work was completed works in 464 (12,04%) and renovated 101 (2,62%) educational institutions, which were damaged because of military actions [11].

In 2022 was observed significant growth quantity the displaced institutions: 131 institutions of higher education education and professional pre-higher education in which 91 thousand studied at that time students (6,7% of general quantity students as of 2022) and worked more than 11 thousand scientific and pedagogical staff (Table 1).

Table 1: The number of displaced educational institutions in 2022 in Ukraine

Institutions and indicators	Institutes, universities, academies	Colleges
The number of relocated institutions	44	87
Including:		
1. According to the form of ownership		
State	27	63
Communal	0	19
Private	17	5
2. According to the level of independence		
Independent establishments	25	40
Branches of other educational institutions	19	47
The total number of teachers working in displaced institutions education, persons	6,9	4,4
The total number of students studying with displaced persons educational institutions, individuals	54,1	37
Cities that received the largest number of displaced educational institutions: colleges and institutes	Zaporizhzhia – 7 Dnipro – 6 Kyiv – 6	Dnipro –15 Zaporizhzhia – 15 Poltava – 11

Source: based on [11]

According to of the EDEBO system in 2022 about 20 establishments education did not have an entrance exam the campaign was not accepted no student. Among these institutions were small branches and specialists colleges, which with a high probability will join the bigger ones universities.

Ministry of education and science of Ukraine also emphasizes on more one problem that arose in connection with the war - migration teachers and scientists abroad. In 2023 a comprehensive was conducted analytical statistical research «Higher education in Ukraine: changes due to the war» according to the materials Analytical Center «OsvitAnalytika» of Kyiv university named after Borys Grinchenko. Within this framework research were going statistical given and conducted poll respondents, which made it possible to analyze in detail influence war on the Ukrainian higher education system education.

Analytical data indicate a significant outflow personnel from Ukraine due to forced migration students, pupils and educators in connection with the war (Table 2).

Table 2: Analytical data on the outflow of personnel from Ukraine due to the forced migration of students, pupils and educators due to the war, as of March 2023

Indicator	Number of students, number of persons
Students on students, which is forced migrated	665 thousand (16% of the total)
Educators who were forced to migrate	25 thousand (6% of the total)
The number of respondents is planned to return to Ukraine	87%
The number of foreign students that studied in Ukraine on January 1, 2022	84136 people
The number of foreign students that studied in Ukraine on March 1, 2023	68712 people

Source: based on [11]

These data indicate the serious challenges that the Ukrainian education system is facing due to the war. The outflow of educators and students affects the quality of the educational process, requires the adaptation of educational programs and the creation of conditions for distance learning both within the country and for those who have gone abroad.

Many graduates work behind the cordon or give priority to freelancing. Private courses are also actively training

IT workers, which will improve the situation rather than increase the problem of staff defects.

Another component of the personnel problem in the IT industry is the urgent need for specialists with at least 2-5 years of work experience (Middle and Senior levels, respectively 37% and 33% of all vacancies on the labor market) (Fig. 1).

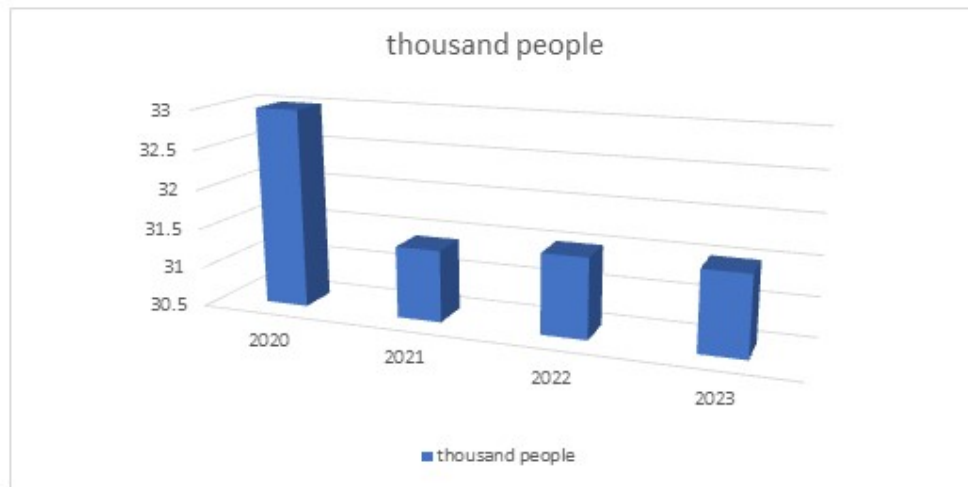


Fig. 1. Number of IT graduates in Ukraine

Formed by the authors based on sources

Ukrainian institutions that provide educational services and training courses are unable to solve this problem, no matter how many new specialists they graduate every year. Ukrainian universities graduated 31,500 IT specialists and accepted 49,700 for the first course in 2023.

Note that, unlike the concept of «education», the term «IT education» or «digital education», despite their relevance, remains a term that has different definitions in various sources. After analysis scientific, reference literature and domestic normative and legal documents, as well as publications in mass media, it is possible to conclude that in Ukrainian «IT education» and «digital» theory and practice «education» are often used interchangeably. But mostly in the mass media is used the term «IT education», while in modern scientific sources more common the term «digital education».

In modern pedagogical research importantly differentiate concept digitization, digital transformation, informatization, digitization and computerization education.

The term «digitalization» is often used to refer to general digital transformation society and economy. Digitization also interpreted as profound implementation digital and innovative technologies in all spheres activity society that functions in conditions era digital opportunities. Thus, digitization society also causes digitization education. The term «digitalization» is popular a synonym the concept of «digital transformation». The terms «informatization» and «digitalization» of education have genus and species relationship «Informatization of education» is wider concept, which is defined as a set interconnected organizational and legal, socio-economic, educational and methodological, scientific and technical, production and management processes aimed at satisfaction information, computing and telecommunication needs of participants educational process and those who manage it and it provides At the same time, «digitalization education» is modern stage her information that provides saturation informational and educational environment electronic and digital devices, means and systems and debugging electronic and communication between them exchange that actually creates cyber physical educational space.

Thus, digitization education is a part wider process digital transformation, and informatization and digitization are different stages and aspects of it process [10].

Detected a lot factors that slow down development of IT education in Ukraine (Fig. 2). Among general reasons are possible highlight perception by the state of spending on education as expenses and not as investments. Also non-codification and conservatism are important educational legislation, personnel crisis among teachers, an inefficient system of financing and management, as well as slow renewal content educational programs and decrease quality educational literature. At the level education observed inconsistency with the needs of the labor market, obsolescence educational programs, absence sequels between different levels of IT education and gender and social imbalance in the choice specialties. Not enough is also a problem cooperation between public and private sectors in the industry education and IT business [9].

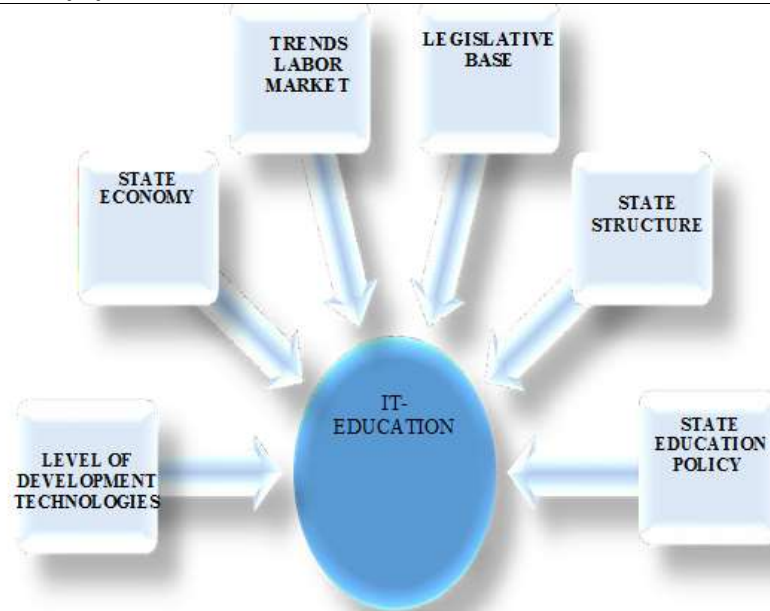


Fig. 2: Factors impact on IT education

Formed by the authors based on sources

Therefore, it is possible to determine the following prospects for the development of the IT industry in Ukraine and the world:

- Ukraine's IT sector is showing significant development despite challenges caused by war and economic instability. Local IT companies are actively innovating, expanding their influence on the international market and developing new directions in the industry. This growth is supported by both internal and external investments, which helps to create new jobs and increase the competitiveness of Ukrainian IT products.
- Technological progress and digital transformation are increasing the demand for new IT professions, such as cybersecurity specialists, artificial intelligence developers, big data specialists, DevOps engineers and others. This creates new opportunities for professional growth and development of skills that meet the modern requirements of the labor market.
- The IT sector is characterized by a high level of remuneration. Salaries of IT specialists in Ukraine often exceed national averages, which makes this industry attractive to young professionals and experienced professionals.
- Flexibility in work is one of the main advantages of the IT industry. IT professionals have the ability to work flexible schedules, which promotes a better work-life balance and increases productivity.
- The number of registered individual entrepreneurs in the IT sector is constantly growing, which indicates the development of legal small IT business. This contributes to the development of entrepreneurship, the creation of new jobs and the strengthening of the country's economy.
- The IT industry offers wide opportunities for rapid career growth. Specialists can quickly move up the career ladder thanks to the acquisition of new skills, certifications and participation in various projects.
- Educational institutions in Ukraine have a certain level of autonomy, which allows them to adapt educational programs to the modern requirements of the IT industry, introduce new courses and cooperate with IT companies to train qualified specialists.
- Ukrainian educational institutions and IT companies actively attract international experience for the training and retraining of IT specialists. This includes participation in international projects, cooperation with foreign universities and participation in global educational programs.

Thus, the prospects of the IT industry in Ukraine are determined by the active development of new professions, a high level of remuneration, flexible working conditions, the systematic growth of small businesses and great opportunities for career growth. International experience and autonomy of educational institutions also contribute to the training of competitive specialists, which is an important factor for the further success of the

industry.

However, there are the following challenges in the field of STEM education and training of IT personnel in Ukraine:

1. Low attention to STEM education (science, technology, engineering, mathematics) leads to a shortage of personnel in the domestic IT market. The lack of stimulation of interest in these disciplines in schools complicates the training of future specialists.
2. Career guidance work in general educational institutions is at a low level. School graduates often do not receive enough information about the opportunities and prospects of the IT industry, which reduces their interest in these professions.
3. Vocational and technical education is not sufficiently popular and is unable to prepare competent specialists for digital workplaces. This limits opportunities for young people to acquire the necessary skills to work in the IT field.
4. Formal higher education is gradually losing its authority due to lagging behind the modern requirements of the labor market. This reduces its attractiveness for young people and contributes to the outflow of potential IT specialists.
5. Educational institutions often do not have modern equipment, which makes it impossible for students to develop the necessary digital competencies. This limits the quality of specialist training and their competitiveness on the labor market.
6. Gender imbalance is a significant problem when young people choose an IT career. Girls are less likely to choose technical specialties, which limits the potential of the IT industry.
7. Institutions of higher education with modern IT programs are concentrated mainly in large cities. This reduces opportunities for attracting talented applicants from other regions.
8. The state recognizes limited results obtained in non-formal IT education institutions, such as diplomas, certificates and certificates. There are also difficulties with crediting ECTS credits, which limits opportunities for professional growth.
9. There is an insufficient number of educational programs for retraining the adult population and representatives of vulnerable groups of society. This makes it difficult for people to adapt to new labor market conditions and their professional development.
10. The lack of both a support regime and proper control over the quality of the provision of educational services by non-formal education institutions negatively affects the level of training of specialists.
11. In Ukraine, there is no clear strategy for the development of IT education and the concept of the development of its levels. This prevents a systematic approach to the training of IT personnel and the formation of long-term plans in this area.

It should be noted that solving these problems requires a comprehensive approach, including reforming the educational system, improving the material and technical base, stimulating interest in STEM disciplines, increasing the prestige of vocational education, ensuring gender equality and creating conditions for the development of informal education.

We propose the following strategic steps for the development of IT education in Ukraine (Fig. 3.):

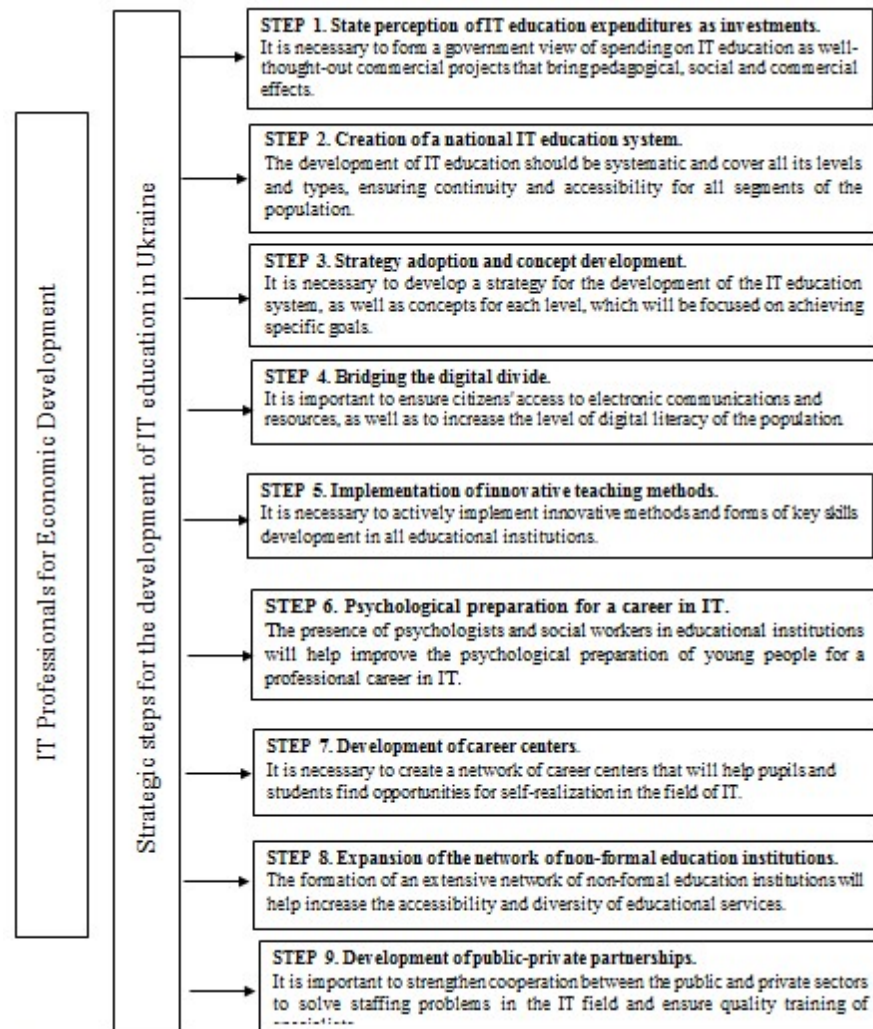


Fig. 3: Strategic steps for the development of IT education in Ukraine

Formed by the authors themselves

Adoption Strategies development of IT education in Ukraine, preparation concepts development of each level and development relevant road maps:

- Overcoming digital inequalities in access citizens to electronic ones communications and resources. Increase general digital literacy people for preparation educated users of IT technologies and members of the digital society.
- Active implementation innovative methods and forms of development modern key skills in education institutions everyone levels.
- Integration through digital competence in teaching everyone discipline in educational institutions.
- Software educational institutions by psychologists and social workers employees who in cooperation with career centers they can to improve psychological preparation young to successful professional careers in the IT field.
- Availability centers many have careers educational institutions that contribute preparation students to self-employment in the IT industry.
- Formation branched network institutions informal education.
- Strengthening of public-private partnership and development dual forms obtaining an IT education . Availability sharp personnel problems in many IT companies that may stimulate their participation in the development of public-private partnership.

Problems and challenges development of IT education in Ukraine you can to display as follows:

- IT education in Ukraine suffering from absence clear regulatory and legal base that makes it difficult development and implementation innovations in this sphere.
- Reforming IT education is often imitative in nature, where it is real changes are replaced formal measures that do not bring practical results.
- Licensing institutions informal education is not enough developed that leads to uneven quality educational services.
- Existing mechanism taxation informal educational institutions has many disadvantages that hinders their effective functioning and development.
- Compatriots institutions informal education faced with unequals tax conditions compared to foreign ones institutions that lowers their competitiveness.
- Quality teaching STEM discipline in schools is unsatisfactory, which negatively affects training students until further notice education in the field of IT.
- Institutions education everyone levels face staffing challenges including unpreparedness many teachers and managers before implementation the newest information and communication technologies (ICT) in education process.
- Teachers suffer significant emotional and physical load that does not match their salary level that may lead to burnout and decline quality teaching.
- Quality teaching mathematical discipline much varies between rural and urban schools that creates unequal conditions for students from different regions.
- Educational training programs specialists for the IT sector often do not respond relevant requirements of the digital labor market, that lowers their efficiency.
- War much worsened the material and financial situation of many families, which makes it difficult organization remote education and limits opportunities to pay for education children in informal institutions education [10].

Based on carried out of research we will form SWOT analysis of IT education in Ukraine, where we will show strengths and weaknesses, as well as threats and opportunities (Table 3).

Table 3: SWOT analysis of IT education in Ukraine

S (strengths)	W (weaknesses)
Rapid growth of the Ukrainian IT sector.	Low priority of STEM education.
Active implementation of new IT professions.	Lack of IT education development strategy.
High level of remuneration in the IT sector.	Lack of control over the quality of non-formal education.
Flexible work schedule for IT professionals.	Insufficient number of retraining programs.
Growth in the number of registered sole proprietorships in the IT industry.	Limited recognition of non-formal IT education.
Opportunities for rapid career growth.	Concentration of educational IT programs in large cities.
Autonomy of educational institutions.	Gender imbalance in choosing an IT career.
Use of international experience in the training of IT specialists.	Outdated material and technical base.
	Decline in the authority of formal higher education.
	Low prestige of vocational education.
	Unsatisfactory career guidance work.
O (opportunities)	T (threats)
Formation of state perception of IT	Conservatism and non-codification of

education costs as profitable investments in commercial projects that bring pedagogical, social and commercial effect. Overcoming digital inequality in citizens' access to electronic communications and resources. A significant increase in the general digital literacy of the population to prepare educated users of IT technologies and competent members of the digital society. Active implementation of innovative methods and forms of development of modern key skills in educational institutions of all levels. Availability of career centers in many educational institutions, which help prepare students for self-employment in the field of IT. Formation of an extensive network of non-formal education institutions. Strengthening of public-private partnership, development of a dual form of obtaining IT education. An acute personnel problem in many IT companies can stimulate their participation in the development of public-private partnerships.	regulatory and legal support. Imitability of reforming IT education. Weak system of licensing of non-formal education institutions. Imperfect mechanism of taxation of non-formal education institutions. Unequal tax conditions for domestic and foreign institutions of non-formal education. Imperfect quality of teaching STEM disciplines in schools. The impact of the war on the material and financial situation of families. Inadequacy of educational programs to the requirements of the digital labor market. Inequality in the quality of teaching mathematics disciplines in rural and urban educational institutions. High emotional and physical stress of teachers at a low level of remuneration. Personnel problems in educational institutions.
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To overcome these challenges, it is necessary to carry out comprehensive measures to reform IT education, improve the regulatory and legal framework, improve the quality of teaching and ensure equal conditions for all participants in the educational process.

CONCLUSIONS

The development of domestic IT education is restrained by numerous factors. The state perceives allocations for education as expenses, and not as investments, which negatively affects funding. The legislative framework remains uncoded and conservative, and reforms are often imitative in nature. The pedagogical sphere is experiencing a personnel crisis due to a lack of qualified specialists. The system of financing, management, organization of the educational process, monitoring of the quality of education and interaction with representatives of the IT industry are ineffective. The content of educational programs is updated slowly and unsystematically, which reduces their relevance. Educational literature is losing quality, and the process of checking the quality of education is becoming increasingly formalized and bureaucratized. A number of problems are observed at all levels of education, including the inconsistency of the pace and quality of training IT specialists with market needs, the outdated content of educational programs, the lack of continuity between different levels of IT education, which prevents the realization of its high potential, the low quality of teaching mathematics in secondary schools, gender and social imbalance, as well as underdeveloped public-private partnerships between educational institutions and IT businesses.

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